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revolving spindle if necessary. Upon its surface a sheet of paper is stretched, on which lines are drawn to represent R.A. and Dec. The R.A. lines are obtained by dividing the circumference of the cylinder into 24 hours &c., and the distance separating the successive lines of declination is obtained from the vertical moment of P. After drawing these lines, all clock stars and all those stars included in the current working list can be plotted and the cylinder mounted. It is adjusted in the first place so that the sidereal time at the instant of mounting corresponds to the same moment of R.A. on the cylinder opposite the centre of P. The apparatus is now ready for use, the only attention required being the occasional winding up of the clockwork.

The rotation of R will bring each star in succession opposite the middle of P (or rather opposite a vertical line through this point) at the moment the real object crosses the meridian, and by moving the telescope until the cross hair of P cuts the picture of the star, we shall bring the object itself into the field of view.

The observer therefore will not require either a sidereal clock or a star list for setting purposes. Standing in front of the telescope he sees by a glance at the cylinder what stars are approaching the meridian, and he sets for any particular one by simply revolving the instrument until the cross hair of P bisects the picture of the selected object.

Adelaide Observatory :
1895 *September* 10.

The Radiant Point of the October Meteors (Orionids).

By W. F. Denning.

So many meteor-showers are now known or suspected, and the great proportion of them are of such feeble and uncertain character, that it seems scarcely desirable to multiply them by further observation. Instead of searching for new and feeble systems, the meteor observer would perhaps be better engaged in directing attention to the rich periodical streams, and investigating their peculiarities with more closeness than has been done hitherto.

It is certain that the features of moving and stationary radiants cannot be well examined in regard to the very feeble showers, but that we must select prominent displays, and such as are pretty durable, like the *Perseids* and *Orionids*. Streams of this character are sufficiently rich and prolonged to be traced very satisfactorily on many successive nights, whereas the minor systems are so tenuous, and apparently so intermittent, that the observer finds it extremely difficult to gather sufficient

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materials to test their visible behaviour. The *Perseids* have already been found to form a radiant subject to a very obvious and rapid motion to the eastwards amongst the stars (*Monthly Notices*, xxxviii. p. 308, and xlv. p. 97–8). But the *Orionids* appear to be typical of a shower having a fixed radiant during the whole time of its presentation (*Monthly Notices*, l. p. 415). I have watched the radiant closely without ever being able to detect the slightest change in its apparent place. The shower commences on October 8, possibly on October 5, and continues until the 29th, but I have only seen it sufficiently well to determine good radiants from October 8 to 24. I have re-examined my observations of this shower in and since 1874, and reprojected many of the meteors registered from it. After correcting some clerical and printer's errors in previously published lists my radiants are as follows :—

Date.			Radiant.		Meteors.
			°	°	
1877	October	8	91	+13½	5
1887		12–13	91	+17	4
1879–87		14	91	+15	6
1879		15	93	+17	16
1887		15	91	+16	17
1877		16	91	+15	15
1877		17	93	+14	33
1884, &c.		17	92	+14	4
1887		17	90	+15	3
1877		18	92	+15	9
1887		19	90½	+15½	10
1877 & 90		19	90	+15	4
1876		17–21	88	+17	8
1874		18–21	90	+17	8
1879		20	93	+15	21
1887		20	90	+14½	22
1887		21	92	+14	23
1878		22	91	+15	11
1887		24	91	+16	9
1874–90	October	8–24	91·1	+15·3 (mean of 19)	228

Many other observers have seen this fine shower and accurately determined its radiant. I have selected the following results as undoubtedly representing the best observations :—

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Date.			Radiant.		Meteors.	
			°	°		
1869	Oct.	5-6	91	+ 9	8	Tupman, G. L.
1869		10	90	+ 12	...	Tupman, G. L.
1893		10	91	+ 16	8	Corder, H.
1869		12	89	+ 16½	5	Tupman, G. L.
1869		13	88	+ 14	12	Tupman, G. L.
1888		13	90	+ 13½	6	Booth, D.
1869		15-16	89	+ 16	15	Tupman, G. L.
1895		16	91	+ 15	6	Corder, H.
1895		16-22	89	+ 13	10	Blakeley, E. R.
1876-9		16-22	90	+ 14	...	Corder, H.
1869		17	91	+ 18	...	Tupman, G. L.
1868		17-18	90	+ 17	32	Backhouse, T. W.
1892		17-23	87	+ 18	9	Corder, H.
1892		17-29	92	+ 15	...	Milligan, W. H.
...		17-31	93	+ 18	5	Heis, E.
...		17-Nov. 13	90	+ 15	...	Greg and Herschel
1864		18	90	+ 16	14	Herschel, A. S.
1867		18-20	90	+ 15	12	Herschel, A. S.
1863		18-21	94	+ 15	...	Schmidt, J. F. J.
1879		19	92	+ 15	8	Sawyer, E. F.
1868		19-21	88	+ 14	14	Wood, W. H.
1868		19-22	92	+ 18	...	Schmidt, J. F. J.
1867		19-27	92	+ 17	...	Schmidt, J. F. J.
1887		20	91½	+ 15	10	Booth, D.
1865		20	90	+ 15	19	Herschel, A. S.
1868		20-31	92	+ 18	64	Zezioli and Weiss (reduced by Denning)
1868		21	93	+ 15	31	Zezioli, G. (reduced by Schiaparelli)
1868		21	95	+ 18	29	Zezioli, G. (reduced by Denning)
1848-68		21	93	+ 18	36	Gruber, L.
1892		...	90	+ 17	...	Backhouse, T. W.
1848-95	Oct.	5-Nov. 13	90·8	+ 15·5 (mean of 30)		

The mean position of these is very nearly identical with the mean derived from observations at Bristol. In the foregoing table I have included Lieut.-Col. Tupman's observation of 1869 October 5-6, though it is unusually early, and though the radiant is 6° south of the proper place. The shower, however, has been so distinctly visible on October 10 to Lieut.-Col. Tupman

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and Mr. Corder, while I have myself remarked traces of it on October 8, that it seems fair to assume its visible opening for October 5.

It is evident that if the radiant of the *Orionids* moved eastwards at the rate of 1° per day (as suggested for ring-formed meteor-systems by the late Dr. Kleiber), its displacement would have been readily apparent. For example, had the radiant occupied the following places the observations must have shown it in the most conclusive manner:—

	°	°
October 12	85	+ 15
18	91	+ 15
24	97	+ 15

for a difference of 12° in the position is very large, and could not possibly have escaped detection. I believe my own determinations of radiants are within 2° of probable error.

The motion, if any, of the radiant would be in increasing R.A., as above; but apart from the test afforded by the comparison of radiants, let us examine the point by selecting such meteor paths (observed at Bristol) as were not far from their centre, and had motions chiefly in declination. It will be seen by the following paths of *Orionids*, recorded from October 12 to 24, that they indicate no displacement whatever in the right ascension of the radiant.

					Path.			
					From.		To.	
		h	m	Mag.	°	°	°	°
1887	October 12	12	19	4	90	+25	89	+29½
1887	15	14	33	3	91	+25	91	+29
1877	16	12	22	3	90	+43	88	+63
1877	16	12	39	1	91	+ 8	91	+ 5
1877	16	13	54	4	94	+ 2	96	− 4
1877	17	14	20	5	91	+20	90	+25
1877	17	14	31	3	95	− 6	96	−15
1877	17	14	37	4	91	− 3	90	−10
1877	17	15	2	3	86	± 0	83	− 7
1895	17	16	5	4	88	− 2	87	− 5
1877	18	17	0	4	86	+10	83	+ 7
1874	19	11	25	4	84	+13	77	+ 9
1887	19	13	9	2	91½	+33	92	+38½
1879	20	8	32	1	86½	+22	79	+29½
1887	20	11	45	4	83	+25	79	+29
1879	20	11	59	4	94½	+22	96½	+25
1887	20	15	5	4	90	+66	90	+74
1887	21	12	5	1	86	+ 5½	83	+ 1½
1887	21	12	35	3	86½	+20	84	+22½
1887	24	12	18	4	91½	+35½	92	+40½
1887	24	12	30	4	95½	+36	97	+43

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The star *ν Orionis* (mag. 4½) is close to the radiant of this shower, as the following comparison will show :—

Place of radiant from 19 observations at Bristol	91°·1 + 15°·3
Place of radiant from 30 observations by various observers ...	90·8 + 15·5
Place of *ν Orionis* (1896)	90·4 + 14·8

A careful comparison of all the radiants given in the two lists will not reveal any indication of displacement. Some of the positions included in the second list are not, however, of much utility in their bearing on this feature, as they depend upon several nights of observation. Between October 5 and 29 the radiant retains a constant position about 1° N.E. of *ν Orionis*. In confirmation of its place near this star Professor Herschel writes : "I had always found the radiant so exactly at *ν Orionis* or so very near to it that that star became synonymous to me with an R.A. and declination place for the shower-centre, and I used it thus, in October 1867, as a just equivalent to a coordinate position."

There are several other showers from the region of *Orion* in October. There is one at 86° + 8° (near *α Orionis*), another at 89° + 20° (near *χ Orionis*), very definitely visible in September as well as in October, a third at 97 + 15 (near *γ Geminorum*), and a fourth at 107° + 12° (near *β Canis Minoris*). The one near *γ Geminorum* has been detected by several observers independently, as follows :—

Date.			Radiant.	Meteors.		
1869	Oct.	14	97° + 10°	9	Tupman	
1879		20	97 + 11	5	Denning	
1892		17–23	96 + 18 99 + 15 98 + 11	22	Corder	apparently a uniform radiant
1871		21	98 + 16	6	Miss I. Herschel Miss J. Herschel	
1868		21	96 + 13	...	Zezioli	
1871		21–23	97 + 15	13	Backhouse	
1875		21–23	96 + 17	9	Backhouse	
1893		22	97 + 19	4	Corder	
1895		23–27	97 + 17½	15	Corder	
1892		...	98 + 18	5	Backhouse	
1894	Oct.–Nov.		97 + 18	5	Corder	

The mean is at 97°·1 + 15°·2, and 6° E. of the *Orionid* centre. The radiant in *Canis Minor* (N.W. borders) is also very distinct,

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and about 10° E. of the γ *Geminids*. The following are five observations of it :—

Date.			Radiant.	Meteors.	
			° °		
1869	Oct.	8	107 + 12	...	Tupman
1877		8–19	103 + 12	22	Denning
1879		15–20	106 + 12	5	Denning
		...	110 + 14	9	Corder
		18–27	108 + 12	...	Schmidt

The mean is at 106°·8 + 12°·4 and about 5° N.W. of β *Canis Minoris*.

There is another active shower at this epoch about 10° N. of this and near δ *Geminorum*. These several displays require further investigation, with special regard to the positions of their radiants. As to the γ *Geminids* (97° + 15°) I cannot quite understand this shower, as I only noticed it on one occasion (in 1879) and then from a position 4° S. of the mean place of the radiant as given by other observers. It is highly probable that many of the true *Orionids* are implicated in producing it, but it cannot be altogether set aside, the observations being too plentiful and corroborating one another in a way not to be disregarded. γ *Geminorum*, which is close to this radiant, is the brightest star a little east of the *Orionid* centre, and we should naturally expect that, in some cases, the observed tracks of *Orionids* would be estimated as directed precisely from that star, though really emanating from a point 6° west. This might sometimes have led the true *Orionid* radiant to be placed a little too far east and near γ *Geminorum*, but the point is one to be cleared up by further observations.

Bristol: 1895 *October* 30.

Observations of Perrine's Comet (c 1895) *made with the Altazimuth at the Royal Observatory, Greenwich.*

(*Communicated by the Astronomer Royal.*)

These observations were made and reduced in a similar manner to those of the Moon with this instrument—viz. transits were taken by the galvanic method over the vertical and horizontal wires for observations of azimuth and zenith distance respectively, and the microscopes and levels were read. A double observation of *Regulus* was obtained on each day to determine the instrumental adjustments.

The following are the individual observations of azimuth and zenith distance :—

G.M.T.						Observed Azimuth.			G.M.T.					Observed Zenith Dist.		
		d	h	m	s	°	′	″		d	h	m	s	°	′	″
1895	Dec.	6	18	7	8	304	19	0·7	Dec.	6	18	23	43	82	1	56·0
			18	21	5	307	11	47·1			18	36	56	80	27	14·1
			18	33	34	309	48	41·4			18	49	41	78	59	41·8
		7	18	48	27	312	39	54·8		7	18	50	36	80	55	55·3